PALM TREES, AND THEIR PRODUCTS.

When the painter wishes to represent a tropical land, he depicts a landscape with palm-trees, and the characteristic physiognomy of the picture is half accomplished. In truth, these graceful denizens of the forest are essentially tropical; only two species, tiny little shrub-like things, scarcely bigger than a lady's fan, being indigenous to any temperate clime. One is called the *Chamærops humilis*, and is a native of Spain, Italy, and Greece. The other, *Chamærops palmetta*, and is a native of North America. In Spain, the leaves of the former are employed as materials for the manufacture of sweeping-brooms.

With the solitary exception of this dwarf species, of all the species of palms which botanists are acquainted with, no less than 175 are trees—sometimes gigantic trees, and always graceful.

But it is not for the sake of their beauty alone that palms are worthy to be noticed. They are not mere elegant sultanas of the forest, spending a luxurious idle life—rearing their proud heads aloft, and waving their delicate plumes to the breeze; far from it—palm-trees, though they are very beautiful, are still more useful; no vegetable genus yielding such a variety of products.

Now, just let us take a glance at these products, and try to enumerate some of the chief amongst them; one may be well pardoned for skipping over some, so varied and so numerous are they.

Let us see then:—There is the cocoa-nut to begin with—this is the product of a palm. And here it is necessary for us to be precise, and to state that by the term cocoa-nut, we mean the large bullet-like thing with a thick shell, and a central cavity filled with a liquid which people are agreed to term *milk*,—not, however, that it resembles the animal fluid very much, even in appearance. This explanation is necessary, inasmuch as some people confound the palm cocoa-nut with that which, being ground in a mill, furnishes the cocoa of the shops—the two have not the slightest alliance, botanical or otherwise; neither does the cocoa-making cocoa-nut grow on a palm. The date, again, is the produce of a palm-tree; and whilst on this topic, the reader's attention may be drawn to a somewhat curious fact. The hard stone which lies in the centre of a date, and which can scarcely be cut by hammer and chisel, so tough and hard is it—this date-stone is the part which corresponds with the edible portion of a cocoa-nut—and conversely, the shell of a cocoa-nut is the corresponding part to the edible and fleshy portion of the date. Cocoa-nuts and dates having suggested their respective trees, the sight of a composite candle reminds us of the oil-palm, that valuable tree which supplies the negroes with a substitute for butter, and helps to form our soap, candles, and lubricating fat for railway axles. Sago, again, is the produce of a palm; as is also the valuable astringent, *catechu*, so useful in medicine and the manufacture of leather. Various in their properties as are the bodies already mentioned, as being the produce of the palm tribe, they are only a few instances chosen almost at random, and give but a faint notion of the rich treasures derived from the tribe of palms.

We have hitherto considered each species as affording us only one single product; but this is hardly doing justice to our friends the palms. For instance, take the cocoa-nut palm. In the first place, it yields us its fruit, the nuts; but these are not a tenth of its products. Those graceful leaves which wave like an enormous plume of ostrich-feathers in the breeze, were once enveloped in a sheath, forming a sort of gigantic, unexpanded bud. In this state it resembles a cabbage in appearance; and if cut just at this period, it is delicious to eat after boiling, forming a very good substitute for the cabbage, to which, indeed, it is preferred by many. Then, again, the juice of the cocoa-nut palm, and indeed of many others, is valuable. If collected and allowed to ferment, it yields a very agreeable wine; but if evaporated whilst fresh, it yields sugar precisely similar to that of the cane. Although the juice of the cocoa-nut palm is saccharine, yet that of the date-palm is more saccharine still. A great many specimens of those finely-crystallised sugars now brought from the East Indies were never extracted from the cane, but were obtained from the juice of various species of palm trees, more especially the date-palm. Returning to the cocoa-palm (fig. 3), and scrutinising its productions more narrowly, we shall find that others yet remain to be adverted to. Who does not know that the external husk of the cocoa-nut yields, when properly manipulated, a valuable textile fibre? In regions where the cocoa-palm grows, this property of the fibre of its husk has been known to the natives from time immemorial; but amongst ourselves the discovery of this property is altogether modern, and resulted, like many other good things, in accident, as follows.

The oil which cocoa-nuts yield, when expressed, was found, about the year 1840, to be a valuable material. At least the oil was in that year applied to the manufacture of candles, being mixed with palm-oil, and treated by a chemical process, concerning which we shall have a little to say hereafter. Well, the process of subjecting ground cocoa-nuts to pressure, in order to extract their oil, requires the use of bags of some coarse fabric. When first the manufactory was established in Ceylon, these fabrics were conveyed there from England; until at last W. Wilson discovered that the best fabric for the construction of pressure-bags was that obtained from the husk of the cocoa-nut itself. Then arose the introduction of cocoa-nut fibre to commerce for many other purposes. Beds are now stuffed with it, mats formed of it—ropes, cordage, hearth-rugs, brushes, and, in short, to so great a variety of different purposes is it applied, that we relinquish, in despair, the task of enumerating them.

Having thus given, by anticipation, a slight view of the great importance of the palm tribe; having mentioned a few of their products, and indicated the purposes to which they are applied—we will now go a little more minutely into the natural history and botany of palms, diverging occasionally for the purpose of taking a glance at the arts and sciences involved in the utilisation of their products. Palms, although usually very large trees, are very nearly allied, botanically speaking, to the lilies and bulrushes, which latter, in general terms, may be said to be their representatives in the temperate zone.

Palms belong to that great division of the vegetable kingdom which botanists term *endogenous*, inasmuch as their stems grow by the central deposition of woody fibre; the word *endogenous* signifying, growing internally or within. It is in tropical lands that the endogenous form of vegetable structure assumes its greatest development, not only constituting certain gigantic trees of which palms are one species, but presenting itself in the shape of bamboos, canes, and grasses, with which we, inhabitants of a temperate zone, can only become acquainted by description, or by the stunted pigmy-like off-shoots which sometimes vegetate (flourish one cannot say) in our palmariums and hot-houses.

All the large trees of temperate climes are of exogenous growth—that is to say, their stem increases in size by annual depositions of woody fibre externally, or next to the bark, whence arises the denomination *exogenous*, which signifies, growing without or externally, just as *endogenous* signifies growing internally or within. The largest endogenous plants which temperate climes produce are the tall grasses, such as wheat, barley, oats, &c.

The determination whether a vegetable belongs to the endogenous or exogenous class is easily arrived at by several modes of investigation, the simplest of which, in cases where it can be applied, consists in the examination of a section of the vegetable trunk. If any of our native trees be cut across, and the plane of section polished, a prime indication of exogenous development will be seen. The trunk will be observed to consist of numerous concentric rings, each corresponding to

the growth of one season, and therefore from an examination of them the age of the tree may be predicted. Moreover, the distinction between pith, wood, and bark will be complete; each of these several portions of the vegetable trunk being well marked.

On cutting across an endogenous trunk—the larger the better, hence the trunk of a palm-tree is best, although the section of a rattan cane affords satisfactory indications—a great difference of structure between this and the structure of the exogenous vegetable will be manifest. In the first place, there is no longer recognisable any well-marked distinction between pith, wood, and bark; all three of which are confused and in a manner blended together. Secondly, the concentric rings, so evident in the other case, and so distinctive, are here altogether wanting. The vegetable tissue appears thrown confusedly together, an appearance which results from the peculiar manner in which the trunk is formed—namely, by the internal deposition of woody fibre,—hence the term *endogenous*.

Perhaps the section of the trunk cannot be obtained. In this case the determination may readily be made by an examination of a leaf. The leaf-veins of exogenous plants are reticulated, whereas those of endogenous plants are parallel.

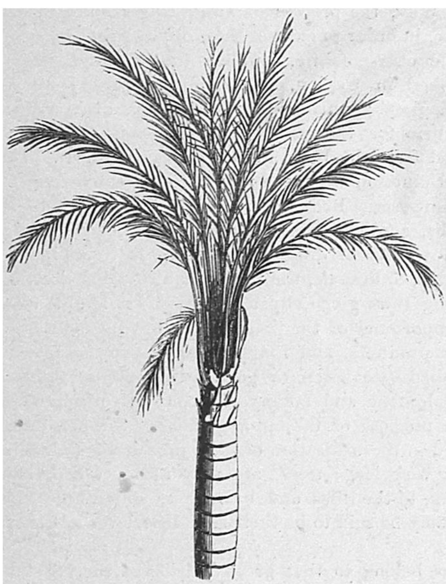


FIG. 1.—THE SAGO PALM (*Sagus Rumphii*).

A third method of distinguishing endogenous from exogenous plants is afforded, at least in the majority of instances, by the seed, which in endogenous plants only consists of one lobe, or cotyledon, whereas the seeds of exogenous plants consist of two. Hence arise the botanical terms *monocotyledonous* and *dicotyledonous*, which are respectively employed to indicate endogenous and exogenous plants. This botanical digression (necessary, however, to the satisfactory comprehension of our subject) has led us away from the consideration of palms, but we will now resume their description.

We have already stated that palm-trees may be regarded as botanically allied to the lilies and bulrushes of temperate regions. Let not the non-botanical reader think the comparison strange; he will find, when he comes to be acquainted with the principles of botanical science, that the mere size of vegetables has little or nothing to do with their alliances. The nature of the organs of fructification is a far surer sign; guided by these and some other appearances, the botanist refers the various members of the vegetable world to their proper natural families. In this way it is found that rose-bushes and apple-trees are very nearly allied; as in like manner are nettles, elm, and fig-trees. It is not our object to explain fully the nature of such botanical alliances, these forming the proper subjects of a treatise on botany rather than an occasional article. We will, however, direct the reader's attention to one little peculiarity of inflorescence, that is to say, the nature and arrangement of flowers; from a consideration of which he will at once recognise a similarity or alliance in this respect between bulrushes and palms. The flowers of both consist of what botanists term a *spadix*, enveloped by a *spathe*.

A spadix consists of a long projection, that imaginative botanists liken to a sword, which, being denominated *spada* in Latin, this form of inflorescence is termed a *spadix*. Arranged upon this spadix, and growing out of it, are seen flowers and young fruit, and enveloping the spadix with its appendages is seen a leaf-like sheath; this latter is termed a spathe. A good example of a spadix enclosed in a spathe is furnished by the *Arum maculatum* of botanists, which is found in hedgerows. The common bulrush, with which our country readers must be familiar, supplies an instance of the spadix without a spathe.

Viewed with regard to their woody fibre, palm-trees exhibit

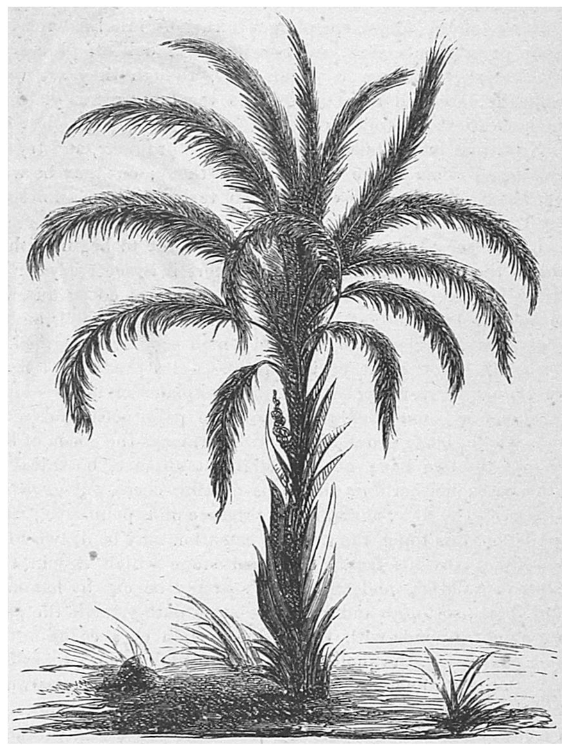


FIG. 2.—THE GUINEA OIL-PALM (*Elæis Guineensis*).

great similarities to the stem of ferns. The likeness may be observed even on examining one of our own English ferns; but the resemblance is still greater when the section of one of the tropical tree-ferns is the subject of comparison. Like these tree-ferns, too, palm-trees must have been created very early in the history of the world. Evidence to this effect is furnished to us by the existing coal-fields of many regions. For the most part, these coal regions consist of fossilised ferns; but the remains of palm-trees are also found: this is our proof.

Palm-trees are now found growing native in Europe, Asia, Africa, America, and Australia; but with the exception of two dwarf species, the *Chamærops humilis*, in Europe, and the *Chamærops palmetta*, in North America, they are all denizens of tropical lands, and their region may be considered as bounded by the thirty-fifth degree of northern, and the fortieth of southern latitude. Nevertheless, one species at least, the date-palm, has been so far naturalised in certain localities of Southern Europe, especially Andalusia and Valencia, that it grows to maturity and produces fruit—though far inferior to the dates of Africa. The greatest authority on palm-trees is

Herr Von Martius, a German botanist, who, with a view of studying their characteristics, devoted three years to a travelling excursion in Brazil—a region more rich in palms than any on the face of the globe. This botanist considers that there are existing at this time upwards of a thousand species of palms. If the opinion be correct, future botanical explorers have a rich field of investigation yet untrodden, inasmuch as no more than 175 species have yet been individualised and described: of these, 119 belong to South America, 42 to India, and 14 to Africa. Cosmopolitan denizens of the vegetable world, as we have seen that palm-trees are, different species culture, and in Central Africa there are none. Botanists are inclined to refer this predilection for the sea-shore to the tendency which these trees have to take up salt; and the idea is partly confirmed by the known fact of their partiality, if the term may be allowed, for alkaline food. In Ceylon, which may be regarded as the head-quarters of cocoa-nut palms, the natives have a proverb, that the tree likes conversation. The houses of Cingalese villages are built amidst groves of cocoa-nut palms, under which condition the trees thrive best. This fact is usually attributed, and it would seem justly, to the fact that the natives treat

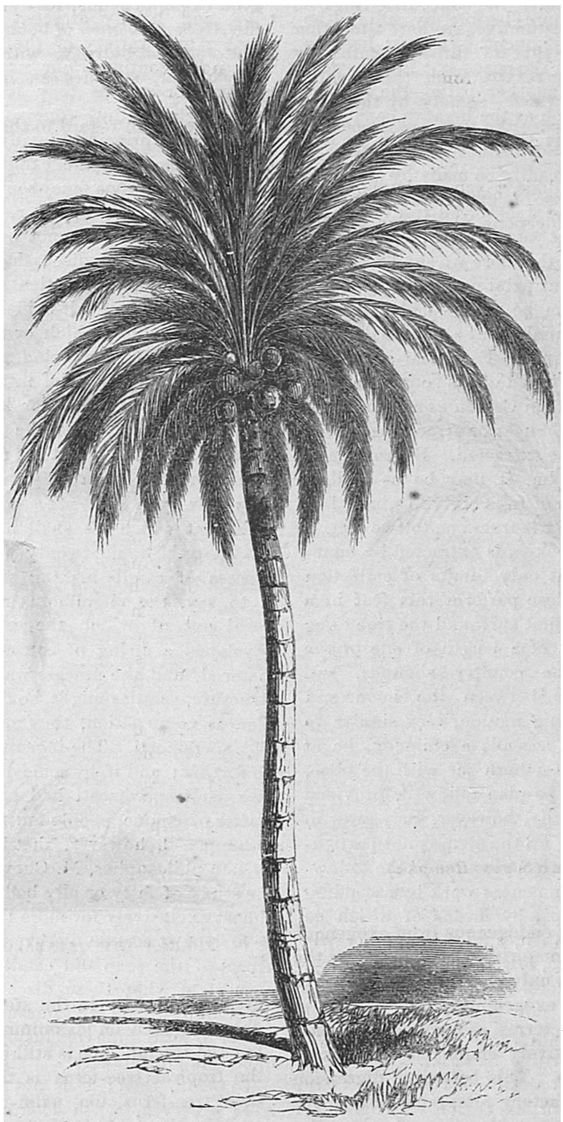


FIG. 3.—THE COCOA-NUT PALM (*Cocos Nucifera*).

affect different localities. Some love to wave on mountain crests, others delight to fringe the sea-coast, and others will only arrive at perfection on the banks of rivers and streams; moreover, with few exceptions, a few species refuse to flourish if taken from their own native land, and conveyed to another of seemingly identical climate. Amongst the few exceptions to this rule, the cocoa-nut palm and the date-palm deserve especial mention; provided the climate be hot enough, and that the sea be near enough, they flourish and bring forth fruit. It is a very curious fact, not satisfactorily accounted for, that the cocoa-nut palm will not flourish at any great distance from the sea: hence, islands are best adapted to their

their conversation-loving friends to a frequent dressing or their own ashes. So great an amount of alkali do the ashes of these trees contain, that the Cingalese washerwomen rarely employ any soap; but steeping the ashes in water to extract the alkali, they employ the resulting fluid.

At the very commencement of our present remarks we stated a few of the purposes to which the various portions of cocoa-nut palm (fig. 3) might be rendered subservient. We mentioned that in addition to the nut employed as food, the external husk yielded material for ropes and cordage; we mentioned that sugar might be obtained from the juice. In addition to these products, the spirit, known as arrack, is dis-

tilled from this same juice when fermented; then the midrib or central vein of the leaf, when properly trimmed, is employed as an oar for rowing; the lower part of the stem yields a wood exceedingly hard, and susceptible of taking so high a polish, that in this condition it might be almost mistaken for agate. In addition to these various applications, houses—good, strong, and substantial—are frequently constructed of the cocoa-palm trunks, and the roofs thatched with cocoa-palm leaves. These same leaves, when cut into strips of suitable length, serve as tablets for writing purposes. Their surface being covered with a flinty coat, the latter is susceptible of removal by the point of a metallic style; and in this way the Cingalese write, or rather engrave, on the leaf with remarkable facility, occasionally rendering the writing more legible by filling the graved indentation with a black pigment. It must here be remarked, however, that although the cocoa-nut leaf answers this purpose very well, there is another palm—the *Talipot*, which answers still better, inasmuch as the breadth capable of being written upon is wider than is the same part in the leaf of the cocoa-nut palm.

We have now, the reader will admit, given a tolerably long list of applications to which these Jack-of-all-trades of the forest are applied; but our list is not yet complete; and, indeed, to complete it would be difficult; therefore we shall rest content with stating, that the cocoa-nut palm not merely gives us a material out of which cordage can be made—and therefore, as a matter of course, cloth if we wish—but also actually furnishes cloth ready made to our hands. Each leaf grows out of a sort of sack, which, being stripped off, is so good a substitute for cloth, that it is employed in Ceylon as a strainer for the cocoa-nut juice, out of which sugar or arrack, according to circumstances, is destined to be extracted. Before finally taking leave of the cocoa-nut palm, it may be as well to state, that it grows to an elevation of from sixty to ninety feet —sometimes more—and its diameter is from one to two feet.

The juice, of which we have spoken, is extracted by puncturing the spathe, consequently it only admits of collection by climbing the tree. The Cingalese perform this feat in a very remarkable manner. They first surround the tree to be ascended with a hoop formed out of a length of one of the climbing plants with which the country abounds, and then the native inserts his legs between the hoop and the tree; and by a sort of wriggling motion, very similar to that by which a chimney-sweep ascends a chimney, he at length arrives at the top, fills his earthern jar with the juice, and comes down again. This is the plan followed, provided the tree stands alone; more usually, however, they grow in groups, and as the act of wriggling up the stem is not particularly agreeable, the dusky operator has recourse to the following ingenious contrivance. He commences work by ascending one tree, carrying with him a rope, by means of which he binds all the tree tops together; then, spider-like, he crawls across his meshes, collects his juice, lowers the pot by a cord, and recommences operations as before.

From the cocoa-nut palm, we now proceed to the sago palm (fig. 1), or more strictly speaking, sago palms, inasmuch as various species yield this nutritive material. Of these, however, the *Sagus farinifera* and the *Phœnix farinifera* are the chief. Sago is neither more nor less than a very delicate, agreeable-tasting starch, constituting the pith, to use a comprehensive term, or, more strictly speaking, the central portion of the stem. Nothing can be more easy than the process of sago extraction. The palm being cut down and split open, or divided into short transverse sections, and the central portion scooped out and washed, the sago is deposited. The only hard and woody portion of the stem of this species of palm is its outside; and of this the natives of Siam and the Malayan Archipelago, where it grows, make the bodies of their drums.

Although Africa is not very rich in species of palms, those which it does produce of this family are exceedingly valuable. Nowhere does the date-palm arrive at greater perfection than in the North of Africa; and the oil-palm of Guinea, concerning which we shall have to say more hereafter, is of the highest importance, as furnishing an excellent raw material applicable to the manufacture of candles, soap, and many other purposes. Appended (fig. 2), the reader will see a representation of this species. He is a very shaggy looking individual, certainly less beautiful than many others we could mention, but perhaps inferior to none in utility.

The Doom Palm of Upper Egypt, an engraving of which is appended (p. 232), instead of shooting up in one stem like other palms, divides like a fork again and again, giving rise to the appearance which botanists term *dichotomous*—*i.e.* the stem continually divides in a binary sense.

Having in the remarks we have already made on palms indicated the general characteristics and the botany of this tribe, and briefly directed attention to the extraordinary number and variety of the products which they yield, we will now continue our notice of these "princes of the tropical forest," as they have been justly called, by just sketching an outline—our space does not admit of more—of the chemical principles involved in the application of palm-oil to the purposes of the candle and soap manufacture. Well now as to soap—we fancy some reader exclaims—there may be something to say; but in respect to candles—with regard to which there surely cannot be anything new to be said—why waste our time by discussing so simple a topic? Candles—we still fancy the impatient reader to exclaim—what can be more simple, more self-evident, than the processes for manufacturing candles, which everybody knows are either dips or moulds?—the former being made by dipping a wick of cotton or other similar material into melted tallow, fat, spermaceti, or something of a similar kind; and moulds, by the more refined plan of casting the tallow, wax, and so forth, into metallic shapes. Impatient reader, if your knowledge of the candle-making art in its present development goes no further than this, you have yet something to learn, and may ponder over that which we shall now proceed to write with some advantage. Some twenty years ago, or at most thirty, the process of candle-making was that described above: that is to say, the manufacturer having first selected the material out of which the candle was destined to be made, enveloped a string of cotton or a length of rush with the material, and the process was complete. As regards form or structure, candles might be divided into dips and moulds; as regards composition, they might be divided into tallow, wax, and spermaceti. The ingenuity of man at that time could go no further; and if, by some dispensation of Providence, tallow, wax, and spermaceti had been annihilated, why then, as a matter of course, people must have done without candles. It so happened, however, that in the year 1811, or thereabout, a French philosopher, M. Chevreul, began to devote himself to the study of fatty or oily bodies. He continued these studies almost exclusively for more than twenty years, and ultimately he arrived at certain discoveries which altogether changed the aspect of the soap and candle manufacture. We will not at once state what these discoveries of M. Chevreul were, or what he did; we will pursue the other course of leading the reader to form some conclusions of his own from an observation of certain appearances.

To begin, then; it is not impossible that the reader may have observed, when looking at a flask or bottle full of olive oil, on a cold day, that the oil had then separated into two portions; one very much like spermaceti in appearance, the other thin and liquid. Now, had it been so desired, this solid portion might have been collected, separated from the liquid portion, and the spermaceti-like body, no matter what it is called, might, if it were found to be sufficiently hard, be made into candles. Had the inquirer proceeded in this manner he would have discovered that the spermaceti-looking substance did not possess sufficient hardness to form candles; but that its melting point was so low as to be incompatible with the conditions necessary to the existence of a candle.

However, although disappointed in this one instance, as to the practical result, a thinking mind would have arrived at a very important deduction, and a very pertinent question would have been raised—*i.e.*, whether oily bodies were really as simple

as they appeared? Whether certain oils and fats, although soft and unctuous to the touch, might not, in reality, be made up of hard fats and thin oils; and, whether, in certain cases, the two might not be separable from each other? This notion, once begotten, many phenomena would tend to strengthen it: for example:—the beautiful substance spermaceti is obtained, as everybody knows, out of the head of the spermaceti whale; so, in like manner, is the bland liquid, sperm oil, the material so admirable as a lamp oil; but whilst the spermaceti whale is alive, these two bodies, namely, spermaceti and sperm oil, remain combined together just in the same manner as the solid and the liquid portions of olive oil. Many other examples exist, but we need not enumerate them; suffice it to say, that the genius of M. Chevreul, starting from these facts as a basis, turned them to some account. He made the important discovery, that all fixed oils—that is to say, all those oils which leave a permanent greasy mark on paper—are made up of several fatty bodies combined together; that some of these fatty bodies are thick, others thin; and, finally, that by certain chemical processes they admitted of mutual separation. This was a great step, but it was not the only step made by M. Chevreul. He next proved each of these separate fatty matters, of which any given oil or fat was made up, to be still further separable into two other parts: these might be a thick and a thin part, or two thin parts; the former class preponderating. This was the grand discovery. It follows, then, that by carrying out the discoveries of M. Chevreul, we might manufacture good hard candles out of olive oil. We have already seen that the thick part of this oil, which spontaneously separates during cold weather, is not, in its natural state, thick enough for candle-making purposes; but the amount of thinness which still lingers in it is not inherent—the thinness depends on the combination of a thin body with it; and this thin body being separated by chemical means, we, in the end, arrive, by the aid of chemistry, to a result—hard, pure, white, semi-crystalline, and very combustible, fitted in every respect for the purposes of the candle manufacture. We have cited what could be done with olive oil as an example only. As matters go, this material is too valuable for that application, and other kinds of oil and fat are too common and cheap.

It is time, now, to explain the chemical principles involved in the discoveries of M. Chevreul, and in what manner these principles are applied to the manufacture of candles from oily matters of naturally thin consistency. We shall impart to the reader a first notion of these principles by directing his attention to a collateral fact. We will assume everybody to be conversant with tartaric acid, the substance which constitutes the acid powder entering into an extemporaneous soda-water mixture. Let it be assumed, then, that a quantity of this tartaric acid is thrown into water, is dissolved by the water: the problem is to get it out. Various means are known of accomplishing this. That which will suit our case best consists in the addition of lime, which, if added in due proportion, combines with the whole of the tartaric acid and forms the tartrate of lime, which admits of separation from the liquid by subjecting the solution to proper treatment, which it is unnecessary, in this place, to describe. Suppose, however, the tartrate of lime obtained, and that the further problem is given of getting the tartaric acid from the lime—how can this result be effected? Simply, thus:—Oil of vitriol being added, in due proportion, it combines with lime and sets tartaric acid free.

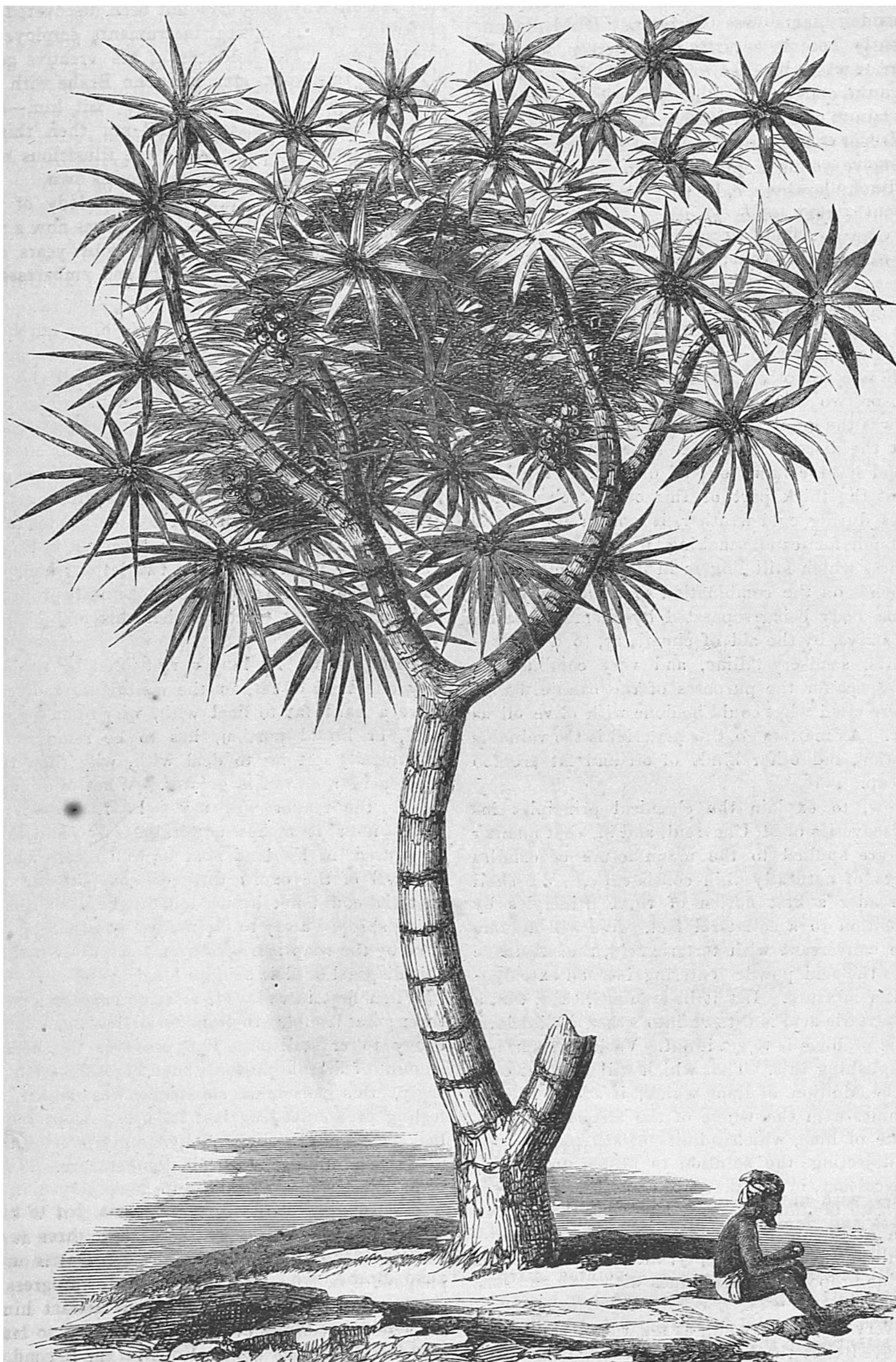
Now the discovery of M. Chevreul, as regards oils and fats, was this:—he proved that the bodies in question, in the first place, were mixtures of many oils or fats; and, in the second place, he demonstrated that each of these consisted of an acid united with a base, just as tartrate of lime is the result of an acid combining with a base; the acid in the latter case being the tartaric, and the base lime. Now, the oily base is a limpid, thin, not very combustible, liquid, termed glycerine; and the oily acids are some of them thick and others thin, but all eminently combustible. These oily acids differ somewhat in their chemical constitution; but we shall be sufficiently near the truth if we consider all the hard ones as margaric or stearic acid, and all the soft ones as oleic acid. Such are the chemical principles involved; now for the application of these principles. Suppose the fatty body operated upon to be lard; everybody knows that this fatty material is much too soft to yield candles at once. But, applying our chemistry, let us now suppose that a portion of lard is melted with lime—what then should take place? Why, clearly, if what we have already said be true, the lime should combine with such fatty acids as the lard may contain (there happen to be two principal ones, margaric and oleic acid), and should set free the liquid base, glycerine. Well, this would advance the operation one step; a portion of the soft matter of the lard would have been got rid of. If now, proceeding with the application of chemical principles, we add oil of vitriol to the oleate and stearate of lime, it is evident that sulphate of lime (plaster of Paris) would result, and the two fatty acids would be set free. Now, one of these, oleic acid, as we have already announced, is a thin acid; we don't want *it* for candle-making, though it is well adapted for the manufacture of soap: we only want for our present purposes the thick or margaric acid. How, then, are we to separate the two? Nothing can be more simple: the mixture having been packed into linen bags, and exposed to pressure at a certain temperature, all the thin acid leaks away, and all the thick acid remains. The latter may be at once applied to the manufacture of candles. Such is a general outline of one of the processes (for there is a second) by which those beautiful candles, termed composite, are now made. By conducting each step of the process with extreme care, it is possible to produce an article superior to the manufacture from either wax or spermaceti; however, in England prejudice runs strong in favour of the two latter; hence, the manufacturers of composite candles do not find it profitable to produce the most perfect candle which this manufacture is able to yield.

Thus we are no longer restricted to the employment of any one kind of fat, in the manufacture of candles. If we have a hard fat to deal with, why then so much less oleic acid, or liquid portion, has to be removed. If we have a naturally soft fat to deal with, why then the quantity of oleic acid removed is greater. What is done with the oleic acid? the reader will ask. Is it thrown away? Certainly not; it makes admirable soap, and for this purpose it is used, in England *now*, as well as elsewhere. Until the removal of the excise duty on soap, however, the valuable material could not be used in England for this purpose; but being shipped away to Germany, was there put into requisition by the soap-manufacturer. At present the necessity for this disposal of oleic acid no longer exists.

When first introduced, stearine candles gave the manufacturer great trouble, their material having a considerable tendency to crystallise. The presence in them of a minute amount of arsenic prevents such crystallisation; and, accordingly, this poisonous substance was added until popular feeling pronounced against its use. At present, the crystallising tendency is obviated by simply pouring the stearic acid into the moulds at a certain temperature. No doubt arsenic is an objectionable substance to be employed in this manner; but, nevertheless, the danger of using it was greatly exaggerated. A certain scientific lady arrived at a remarkable conclusion on the subject, which we may as well cite for the purpose of demonstrating the fallacy of a very pretty speculation. "I do not think," said this lady—"I do not think that the arsenical candles evolve any noxious amount of the mineral until they have burnt down rather low; but *then*," continued she, "the odour is very oppressive, because all the arsenic, by virtue of its great weight, sinks to the lower end of the candle in the process of casting." "Madam," interposed a gentleman well conversant with the candle-manufactory, who heard this explanation, "*but candles are cast upside down; therefore the arsenic, according to your view, should be in their tops!*"

One word more about the candle manufacture, and it is this:—although the process we have described for separating

stearic from oleic acid is the general one followed, there is another exclusively employed in large metropolitan candle-factories. To describe this process now would be far too long an affair; we may perhaps do so on another occasion. *En passant*, however, we may remark, that although the steps of the process are different, the general results are the same.



THE DOOM PALM OF UPPER EGYPT.

Some very important social and political considerations arise from a study of the discovery of M. Chevreul. Vegetable oils seem destined in future to supersede tallow as furnishing the raw material for the soap and candle manufacture. Now palm-trees are the greatest sources of vegetable oil, and the quantity which may be obtained from these denizens of the vegetable world is in a manner without limit. Africa is the region of these palm-trees;—the western coast—slave-trading region of Africa. It follows, then, that as our palm-oil trade increases, and native labour becomes valuable; so in that proportion will the slave trade diminish. It follows, moreover, that we cannot be, as we have been, mainly dependent on the supply of animal fat from foreign countries—chiefly Russia. Thus has science been true to her genius; the discoveries of a French philosopher in relation to fats, independently of adding to our comforts and luxuries, are increasing our national independence, developing our commercial resources, breaking down a foul traffic, and ameliorating the social and political relations of the whole world.